Impacts of Restructurings on Manufacturing Productive Efficiency: Evidence from China

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Abstract

This paper studies the effects of privatization and non-ownership-change reforms on firms' productivity in China. As one of the most prominent empirical challenges in China privatization studies, endogeneity problems are addressed with a first-difference instrumental variable GMM estimation. We find that privatization does not improve firms' productivity immediately. Instead, its effects become significantly positive in the year after conversion. In addition, partial privatization fails to lead to improved efficiency whereas insider privatization boosts firms' productivity shortly after the first year of privatization but the effects quickly fade after two years of privatization. Lastly, all non-ownership-change reforms, except leasing, are proved to be ineffective even when issues like social burdens, worker redundancy, management incentives and soft-budget constraint are tackled before the restructuring.

Keywords: privatization, soft budget constraint, transition economies, Chinese economy
JEL Classification: L25, P27, P31

1. Introduction

While privatization has gained popularity as a remedy to aid failing state-owned enterprises (SOEs) across the world, the process of privatization in China has always been gradual and cautious. Such a gradualism approach is largely attributed to the fear that the government may lose control of the country's economy if SOEs are massively privatized. Therefore, unlike reforms of SOEs undertaken in the former Soviet Union and Eastern European blocks, Chinese government has taken a more comprehensive approach to improve efficiencies at its SOEs. This approach includes ownership change, namely privatization and reforms without relinquishing state controls. To shed light on the effects of this hybrid restructuring strategy on Chinese firms' efficiencies, this paper uses a Chinese firm-level panel data to examine the effects of privatization and non-ownership restructurings on firm's productivity in China. A study on privatization in China is warranted given that most current literature has focused on the merits of privatization process in Central and Eastern European countries where privatization has mostly yielded significantly positive effects on firms' performances. Moreover, a study on China's SOE restructuring may also add new evidence and insight to the existing body of literature on firms' efficiency in transition economies. Lastly, the effects of partial privatization or reforms without compromising state controls, such as leasing and employee shareholding etc., on SOEs have not been extensively examined by researchers as the effect of privatization.

The empirical research on Chinese SOE reform has faced several hurdles. First, Chinese firm-level data with sufficient information on reform and ownership structures has largely not been available. This data constraint is mainly caused by the policies adopted by the Chinese government to privatize its SOEs. Even though the economic reform started as early as 1980, the sale of SOEs was meagerly allowed until 1995. Therefore, previous studies of Chinese privatization have been hindered either by too short time period to be adequate for time series analysis or by too few numbers of privatized SOEs to be adequate for cross sectional analysis. Utilizing a more recent dataset with a longer time span and larger sample size of privatized SOEs, this paper should be able to ascertain the restructuring effects more reliably than previous studies.

Second, endogeneity problem has been well documented in most research on Chinese privatization. The persistence of this problem may come from two sources. One is selection bias due to the fact that Chinese SOEs have been deliberately selected by the government for different restructuring strategies. Yao (2005) find that better-performing SOEs are more likely to be chosen for privatization. Thus, when one attempts to examine the impacts of SOEs restructuring on their efficiencies in China, the findings may not be warranted as robust or reliable if the selection bias is not sufficiently addressed. Second, the endogeneity problem may also arise when firms modify their production behavior in anticipation of future ownership changes or restructuring. For example, firms may attempt to be more productive if future privatization is anticipated. By doing so, they may attract higher bids from private investors. If this "anticipation effect" does exist, then a general panel data treatment, such as a within or first-differenced estimator, may violate the strictly exogenous condition for panel estimation. To address these two sources of endogeneity, this paper proposes a first-differenced instrumental variables general method of moments (IV-GMM) approach. With this approach, the selection bias can be controlled by introducing several exogenous instrumental variables (IVs) whereas the violation of strictly exogenous condition in a panel setting can be eased by estimating a first-differenced model with lagged value of the chosen IVs. Moreover, firms' performances in the pre-privatization periods are later used to facilitate a specification test to examine if the endogeneity problems have been effectively controlled with the IV GMM estimation.

Third, an omitted variable problem may also arise if a firm's current production level is correlated with its manager's or local government's previous expectation of its future ownership changes. For instance, if privatization is expected to occur in the future, the managers may not only adjust the firm's current production but also change the firms' future production strategies accordingly. As a result, failing to consider the impacts of managers' current expectations of a firm's future restructuring on its future production may cause an omitted variable problem. By using the lagged values of instrumental

variables to estimate managers' expectation of future ownership change this paper may adequately address this omitted variable problem.

The focus of this paper is to examine the effects of privatization and other non-ownership restructuring strategies on Chinese firms' productivity growth. The empirical results show that privatization may not yield significantly positive results on firms' productivity growth immediately but only until one year after privatization takes place. It is found that firms' productivity growth may increase as much as 214 percent in the first year after privatization. In addition, other reform measures also affect firms' productivity growth significantly and the effects of these reform measures appear to be more immediate than those of privatization. Downsizing of the number of retired workers and excessive debt are found to boost productivity growth, on average, by 37.3 and 5.2 percents respectively in the same year of reform. Hardening budget constraint is found to only have marginal impacts on firms' productivity growth, but the effects are positive and significant. Moreover, the effects of partial privatization on firms' productivity growth are also estimated. The results indicate that partial privatization induces no significant effects on productivity growth. This may imply that introducing private ownership to SOEs cannot improve firms' efficiency unless private shares exceed the 50 percent threshold. Furthermore, to investigate how various types of private ownerships affect productivity growth in former SOEs, privatized firms are further disaggregated into insider and outsider or domestic and foreign owned. Insider privatization shows significantly positive effects on firms' productivity growth; yet no significant changes are found for other forms of privatization.

Lastly, this paper also obtains some insights on the optimal sequencing for non-ownership restructuring. Without first taking step to harden soft-budget constraints properly and to reduce excessive debts at SOEs, all non-ownership restructuring attempts appear to be in vain. However, leasing SOEs to managers or private investors seems to increase productivity growth by 55 percent on average if soft-budget constraint and excessive debt are eased.

The reminder of this paper proceeds as follows. The next section reviews the theoretical and empirical literature of privatization and more specifically those related to the reform in China. Section 3 provides a brief historical background of Chinese privatization. Section 4 describes the data set used in this paper. Section 5 explains the econometric methodologies used and the empirical results are discussed in Section 6. Section 7 summarizes and concludes.

2. Literature Review

Privatization has been widely used by governments in the world today to resolve the impending failure or improve the performance of SOEs. Megginson and Netter (2001) and Djankov and Murrell (2002) provide comprehensive surveys on the current development of theoretical and empirical studies on privatization. Their work focuses more on the privatization that took place in the "transition economies".[1]

2.1 Theoretical Literature on Privatization

The economic theory of privatization could be categorized into two branches: The Public Interest Theory and the Principal-Agent Theory[2]. Public interest theories emphasize the effectiveness of SOEs to solve market failure caused by private firms in an unregulated oligopoly market. In contrast, Principal-Agent theories tend to address productive inefficiency of SOEs arising from asymmetric information.

Public Interest theories state that "Political intervention can help when markets fail, provided that the cure does not cost more than the disease".[3] In other words, a SOE may be better than a private firm in improving social welfare by allocating resources more efficiently. Public ownership leads a SOE to take account of not only profit but also consumer surplus that a private firm is inclined to ignore. Therefore, in a natural monopoly market, private ownership would be biased toward setting a higher price. As a consequence, the gain of social welfare from cost reduction might be offset by the loss

[1] formerly socialist countries or communist countries undertaking economic reforms
[2] See Vickers and Yarrow (1988)
[3] See Willner (2003), page 61.

caused by market failure. Willner (2003) proposes a theoretical model which starts with a monopolistic public firm. This public firm maximizes a social welfare function. To compare the change in social welfare under a private firm setting, he also considers the case that the public firm is replaced by an n-firm Cournot oligopoly. The comparison of the social welfare under different types of ownership shows that public ownership doesn't necessarily imply inefficiency. Actually, private ownership might lend to social welfare improvement over public ownership only when the cost reduction it induces exceeds a certain threshold. In addition, Shapiro and Willig (1990) and Vickers and Yarrow (1988) also investigate the advantages of public ownership over private ownership.

The Principal-Agent theories, on the other hand, weight more on the SOE's internal inefficiency which is primarily caused by asymmetric information between the residual claimant and the manager of the firm. It argues that the principal-agent problem can't be sovled without transferring public ownership to private owners, as SOEs are unable to eliminate this internal inefficiency by themselves. On the contrary, with the introduction of certain regulations, the merits of private firms may persist and social welfare would be improved after privatization. Principal-Agent theories can be classified into two complementary approaches which differ by modeling who plays the role of the agent, a politician or a manager.

The Principal-Agent theory with a politician being the agent stresses the interference from the politician. SOE may be used to fulfill some personal objectives of that politician, for example, over-employment and election wins rather than social welfare maximization. Shleifer and Vishny (1994) and Boycko et al. (1996) develop a principal-agent model with three players: treasury, politician and manager. In their model, the treasury is concerned with profit and controls cash flow; the politician responds to voters' needs (more jobs available) and is able to help the SOE get subsidies; the manager maximizes profits and bribes politicians in the hope of receiving more subsidies from the state but carrying less burden of the cost of employment. Since the treasury doesn't have full information on the firm's profit, the politician can help the manager to conceal profit and ask for more subsidies in exchange for more employment. Thus,

inefficiency of the SOE occurs because of asymmetric information and that the transfer of information is costly. Arin and Okten (2003) adopt similar model to examine the effects of privatization on firm's efficiency and disparities in technology adoption between public and private firms. They show that privatization reduces unit cost and that public firms prefer to maintain labor-intensive technology.

Differing from the politician theory, the Principal-Agent with manager theory considers a typical principal-agent problem which only involves state (principal) and manager (agent). In this type of model, the state is the residual claimant and determines the reward to be given to the manager. However, the state is poorly informed about the firm's performance. The manager, on the other hand, decides how hard he (or she) wants to work and has full knowledge of how well the firm is doing. Vickers and Yarrow (1988) first explore this scheme of the principal-agent problem. Bös and Peters (1991) add uncertainty and external control into the model. They find that the SOE would be competitive in terms of cost reduction only when the state of the economy is good.

With regard to theoretical analysis of Chinese privatization, there are very few studies in the literature. Zhang (1997) models the effects of reform on the performance of a Chinese SOE. He finds that shifting decision rights and residual claims from the state to the manager and hardening budget constraints can motive the manager to work hard and thus lead to better performance. He concludes that further improvement of efficiency depends on privatization of the state enterprises.

2.2 Empirical Literature on Privatization

Regarding the effect of privatization in transition economies, Brown et al. (2006) presents the most comprehensive empirical analysis of the effects of privatization on the firms' productivity in four former communist countries, Russia, Ukraine, Romania and Hungary. They take into account the firm-specific effect and firm-specific time trend effect. They conclude that while the effects of privatization differ in magnitudes across these four nations, the results are robust in that privatization significantly increases productivity in all nations. Moreover, they also find that firms privatized by foreign

investors achieve more sustainable growth in productivity than those privatized by domestic investors. This paper applies their methodologies to a Chinese dataset. Comparison of the results from this study and theirs may shed light on how the effects of privatization differ across countries adopting different transition strategies.

Turning to the empirical literature on privatization reform in China, Jefferson and Singh (1999) offer a comprehensive review of industrial SOEs' reform and privatization process in China. Cao (2000) provides a chronology of Chinese privatization since 1978. She also evaluates the consequences of the reform policies that China had adopted during the ownership transition of SOEs. Lin et al. (1998) discuss several issues associated with the managerial and ownership reform of China's SOEs. They conclude that without the easing of policy burdens and the removal of the soft budget constraint, there is little prospect for SOEs to achieve better performance. Dong and Putterman (2003) study the effect of hardening the budget constraint on the redundant labor problem in Chinese SOEs and find that unlike in developed economies[4], hardening budget constraint in China only results in an increase in redundant labor if the firms' social burdens are not lessened.

Jefferson and Su (2006), *Xu et al. (2005)* and *Song and Yao (2006)* also study the effectiveness of Chinese privatization on firm performance. Using a large panel data of Chinese SOEs, *Jefferson and Su (2005)* find that a larger non-state share improves the performance of firms. However, the lack of share structure information in their data limits the reliability of their conclusions. Analyzing a national survey of the ownership reform of industrial SOEs in China, *Xu et al. (2005)* reach several interesting conclusions. In particular, they find that the success of reform positively correlates with reduced political control affording the firms more flexibility in labor deployment. Song and Yao (2004) use the same dataset as being used here to address the effects of privatization on firm performance. Nonetheless, this study differs from theirs in two ways. First, in addition to controlling the firm-specific effect as they did, this study also considers the

[4]They compare the SOEs' reform in Italian to that in China.

firm-specific time trend. Second, they did not distinguish the effects of privatization associated with different types of private ownership whereas this study does.

Finally, *Dong et al. (2002)* study the impacts of share ownership reform on employee attitudes in China's privatized rural industries. *Qi and Zhang (2000)* use firm data from the Chinese stock market to address how changes in the shareholding structure can affect the performance of stock exchange listed companies.

3. Privatization in China

While the reform of SOEs in China began in 1978, a considerable amount of privatization of small and medium size SOEs did not take hold until middle of the1990s. Unlike the massive privatization which occurred in Eastern European countries, China initially took a comparatively slow and gradual approach to proceed with privatization. The primary goal of the Chinese government in privatizing some SOEs was to improve the efficiency of those firms rather than to reduce the influence of the government on firm operations. However, later on, the privatization process picked up speed gradually and apparently, the central government also showed strong support for privatization in certain industrial sectors and for certain size firms. This reconstruction of SOEs' ownership is not only open to domestic private firms but also to qualified foreign firms allowing them to buy a certain percentage of the shares of SOEs. The trend of this privatization process is more obvious by viewing Table 2. In 1995, only 3.52 percent of firms in the sample had been privatized. However, in 2001, over 20 percent of firms had been privatized.

The Chinese privatization process can be viewed as unfolding in three stages. The first stage began in the early 1980s. That was the period when China started to experiment with a new economic system in which a non-state sector was created to coexist with the state sector. The new non-state sector, though very small, indeed manifested the benefits of privatization, such as quick response to the change of the market and more efficient operation. However, the success of the newly created privatized firms did not lead to a broader scale of privatization in the economy. The

second stage began in the early 1990s. The Chinese government launched a series of measures to reform the SOEs. This industrial reform tried to inject a system of managerial incentives to improve enterprise efficiency without altering the state dominance in ownership of enterprises. Li (1997) shows that by injecting incentives and decentralizing the economic decision-making process, the total factor productivity was improved dramatically. The third stage began in mid 1990s. That was when the Chinese government implemented an aggressive privatization program guided by a policy called "retain the large, release the small", which is to retain only 300 or so largest SOEs and privatize the rest. However, even though the scale of this privatization program is remarkable, the Chinese government did not actually "release the small" but rather retained substantial influence on these privatized firms. Megginson and Netter (2001) and Lin (2000) point out that for most of the so-called "privatized" firms, the government is still the biggest share-holder, and that less than one-third of the shares of those firms are sold to private investors. In addition, the goal of this stage (stage three) is not only to improve the efficiency of SOEs but also to develop the security market in China. Thus, the effect of this privatization effort is still unclear and is the interest of this study.

4. Data Description

4.1 Selected performance and production factors

This paper uses the data from Song and Yao (2004), which is based on a survey conducted by International Finance Corporation and National Bureau of Statistics in 2002. This survey includes 863 firms in 11 cities with information on accounting, employment and the corporation governance.[5] The gross value of total output, unit cost and profitability are chosen to measure performance changes of Chinese SOEs during the sample periods. The gross value of total output is adjusted for inflation with 1995 price index as the base year. Unit cost is considered in order to capture the effort exerted by the managers on cost reduction. It is reflected by the percentage of managerial and operational costs over total value of output. Profitability is defined as return to assets

[5] These 11 cities are Harbin, Fushun, Tangshan, Xining, Lanzhou, Chengdu, Guiyang, Weifang, Zhenjiang, Huangshi and Hengyang.

which is the percentage of the pre-tax profit over the total value of assets. Table 1 presents the descriptive statistics (mean and standard deviation) of these performance indicators as well as two major input variables, namely total number of on-duty employees and total value of assets over the period of 1995 to 2001. A clear declining trend in labor usage can be observed over years and this may be attributable to various reform efforts. It is also notable that the average gross value of total output for sampled firms has increased from 29 to 38 million Chinese Yuan. However, there is no sign indicating any improvements on the average profitability among the sampled firms. It shows that on average firms have faced negative return to asset from 1995 to 2001. Such negative profitability may be attributed to the ever-increasing competition in the market. Lastly, the trends of changes in average unit cost and capital are rather mixed.

Table 1: Descriptive Statistics of Performance and Input Variables in the Sample

Year	Output	Unit Cost	Profitability	Labor	Capital
1995	29.08	1.43	-0.05	680.78	45.01
	(43.78)	(2.85)	(0.12)	(1057.79)	(59.17)
1996	31.44	1.35	-0.06	658.64	55.17
	(46.25)	(0.87)	(0.08)	(1026.17)	(68.91)
1997	32.03	1.99	-0.06	632.75	59.71
	(51.50)	(6.32)	(0.08)	(1030.09)	(73.93)
1998	31.38	2.02	-0.07	588.78	63.90
	(49.33)	(4.08)	(0.09)	(1120.07)	(78.59)
1999	33.22	4.31	-0.06	544.63	62.68
	(56.11)	(40.37)	(0.08)	(1076.15)	(76.39)
2000	32.32	2.18	-0.06	492.10	58.48
	(52.39)	(6.03)	(0.11)	(985.02)	(71.58)
2001	37.84	3.25	-0.06	463.73	59.61
	(37.84)	(18.06)	(0.10)	(1023.18)	(74.92)
Average Sample Size	426	390	396	573	517

Note: Sample size is expressed in the unit of the number of firms. Output equals the value of gross output and is measured in Chinese currency (unit: million Yuan). It is adjusted by the ex-factory price indices of industrial products (year 1995 is chosen as the base year). Unit cost is the ratio of operation cost (total sales minus pretax profit) over total sales. Profitability is measured by the ratio of pretax profit over total asset. Labor equals the number of working employees. Capital equals the value of total asset and is measured in Chinese currency (unit: 10,000 Yuan). It is also adjusted with price indexes. Standard Deviations are shown in the parenthesis.

4.2 Ownership distributions

The construction of ownership variables follows the standard procedure in the literature on privatization in the transition economies (Brown et al (2006) and Song and Yao (2004) etc.), in which a firm is defined as a privatized firm if the shares owned by the state are less than 50 percent, otherwise a firm is considered to be a SOE. While the data includes the year of conversion, it does not provide information on the specific date of the occurrence. Thus, we assume that a privatization normally begins at the beginning of the year of conversion and is completed at the end of that year. [6]

The summary statistics of the ownership changes are displayed in Table 2. It concurs with the literature which indicates that the privatization process merely started in China in 1995 and began to accelerate significantly after 1997. By the end of the sample period, privately owned firms account for 21 percent in the whole sample. Among the privatized SOEs, 97 percent are privatized by domestic investors. These investors may include top and middle managers, ordinary employees, domestic private firms, or legal persons (entities). In contrast, foreign investors are still facing strict limitation from participating in the Chinese SOE privatization process. In 2001, the percentage of firms owned by foreign investors even declined to 0.52 percent. In addition, the percentage of firms privatized by insiders has surged from 0.29 percent in 1995 to 13 percent in 2001. Insiders may include managers from various levels and ordinary employees (the rank and files). On the other hand, privatization initiated by outsiders, who may include legal persons, domestic private firms, and foreign firms, has moderately increased from 3 to 8 percents during the sample period. It seems that domestic and insider privatizations have gained more popularity among SOEs as paths toward privatization.

[6] The actual transfer of the share of privatized firms may take months or years to complete. (Megginson and Netter (2001)).

Table 2 Ownership Distributions in the Sample (in percentage), from 1995 to 2001

	1995	1996	1997	1998	1999	2000	2001
Private total	3.52	3.41	3.97	7.32	10.3	15.78	20.73
Domestic	2.64	2.84	3.4	6.76	9.49	14.97	20.21
Foreign	0.88	0.57	0.57	0.56	0.81	0.8	0.52
Insider	0.29	0.57	1.13	2.54	4.07	9.09	12.86
Outsider	3.23	2.84	2.83	4.79	6.23	6.68	7.87

Note: This table shows the ownership distribution in the sample data. All values are in percentage. Private total refers to the percentage of all private firms; domestic refers to firms privatized by domestic private owners; foreign stands for firms privatized by foreign investors; insider refers to firms owned by their own employees and managers; outsider refers to firms whose majority shares are sold to outside investors.

4.3 Non-ownership-change restructurings

Chinese central government has always preferred to improving SOEs productive efficiency without further compromising state controls in SOEs. As a result, before privatization was officially endorsed, most of Chinese SOEs have gone through a variety of non-ownership reforms. Most of the non-ownership reforms are aimed at clarifying or reallocating property rights over firms' assets and liabilities. Garnaut et al. (2005) identify seven major forms of restructuring in China. These restructuring efforts include initial public offering (IPO), internal restructuring, bankruptcy, employee shareholding, open sales, leasing and joint venture.

If a firm chooses to take IPO, employee shareholding, open sales or joint venture, it may become private-owned. Thus, we will only consider internal restructuring, bankruptcy and leasing as non-ownership-change reforms in this paper. Internal restructuring refers to incorporation in the context of Chinese SOE reform. This reform does not change the ownership of a firm, but forces it to verify its legal ownership. During years of reform, SOEs are required to convert themselves into either limited liability (small SOEs) or limited liability shareholding companies (large SOEs). After Bankruptcy Law came into effect in 1988, Chinese SOEs are now allowed to claim bankruptcy. As Garnaut et al. (2005) show, bankruptcy policy has been widely abused by poorly performing SOEs as a tool to evade debt payments. When an investor cannot

afford to privatize a SOE, he (she) would most likely choose to lease the SOE. Leasing does not change a firm's ownership, but it often gives the management or the lease holder more autonomy to operate the business.

Table 3 presents the percentage of firms in the sample that have at least taken one form of restructuring. Within the sample, some firms have undergone more than one round of restructuring. However, to identify the effects of different restructuring on firms' productivity growth, this study only considers the first round of reform that a firm ever took. Table 3 shows that the non-ownership-change reform process has also gained momentum after 1995. There were only 1.47 percent of the sampled firms ever undertaking a restructuring in 1995 whereas 61.34 percent of firms have taken at least one round non-ownership-change reform by the end of 2001. Among all non-ownership-change restructuring policies, internal restructuring is the most popular one. By the end of 2001, 32.44 percent of SOEs have been incorporated. Bankruptcy and leasing appear equally attractive as reforms proceed. 12.89 and 16.01 percents of SOEs have chosen bankruptcy or leasing respectively in 2001. However, leasing has become more appealing to SOEs than bankruptcy after 1997.

Table 3 Non-ownership-change Restructuring Distributions (in percentage), from 1995 to 2001

	1995	1996	1997	1998	1999	2000	2001	Total
Reform total	1.47	5.11	7.36	8.45	12.2	12.84	13.91	61.34
Internal restructuring	0.88	1.7	3.68	5.35	7.05	7.22	6.56	32.44
Bankruptcy	0	2.27	2.55	1.41	1.63	2.14	2.89	12.89
Lease	0.59	1.14	1.13	1.69	3.52	3.48	4.46	16.01

Note: This table shows the non-ownership-change reform distributions in the sample from 1995 to 2001. Reform total indicates the percentage of sampled firms that have undergone a non-ownership-change restructuring. All values are in percentages.

5. Endogeneity and Model Specifications

5.1 The sources of endogeneity

A typical estimation on impacts of privatization on firms' productivity can be specified as the following.

$$(1)\quad y_{it} = \beta_1 l_{it} + \beta_2 k_{it} + \beta_3 priv_{it} + \beta_w' w_{it} + \beta_{yr}' year_{it} + u_i + \varepsilon_{it}$$

Where y_{it} is logarithm of the gross value of total output and l_{it} and k_{it} are the total number of on-duty workers and total value of assets in logarithm, respectively. $priv_{it}$ stands for ownership dummy. It takes the value of 1 if the percentage of total private shares in a firm exceeds 50 and equals 0 otherwise. w_{it} is a vector which represents other determinants of a firm's efficiency in China. It includes managers' incentive, degree of social burden, degree of soft budget constraint, and excessive debt. Managers' incentive is measured by the percentage of total shares owned by top and middle managers; the ratio of number of retirees to the total number of employees is used to measure social burden; soft budget constraint is constructed as the ratio between the value of current overdue loans and the total value of loss (in negative term) in the previous year. The higher this value is the less degree of soft-budget constraint a firm may face; excessive debt is calculated as the sum of overdue loans and overdue interest payment at the year-end. Lastly, u_{it} stands for the fixed-effects and ε_{it} is a Gaussian error term.

The estimation of Equation (1) requires extra caution because endogeneity problem may occur. In this particular study, as stated earlier, endogeneity may come from several sources. First, selection bias may arise if the decision of a firm's privatization partially depends on some variables related to the firm's performance, but unobservable to researchers. That is, $priv_{it}$ and ε_{it} may be positively correlated. This correlation may be caused by some time-invariant variables. Such time-invariant variables may include locations, industries or the relationships between management and local officials. A fairly

straightforward panel data transformation procedure can remove these time-invariant effects. Thus, we take first-difference of Equation (1) to remove the fixed-effects u_{it}.

$$(2)\quad y_{it} - y_{it-1} = \beta_1(l_{it} - l_{it-1}) + \beta_2(k_{it} - k_{it-1}) + \beta_3(priv_{it} - priv_{it-1}) + \beta_w'(w_{it} - w_{it-1}) + \beta_{yr}'(year_{it} - year_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1})$$

However, it is also possible that some unobserved variables may be time-variant. For example, the quality of a manager's managerial skills may likely influence a firm's privatization decision as well as its performance. Since better performing SOEs are more likely chosen for privatization, ε_{it} will continue to be positively correlated with $priv_{it}$ and an upward bias will persist in the estimated coefficients. Second, a firm's current performance may also affect its future privatization decision, which suggests that ε_{it} may be correlated with $priv_{it+1}$, a firm's ownership status in the next period. In that event, the strictly exogenous condition for panel data estimation is violated and a new source of endogeneity is introduced after first-differencing Equation (1). To be specific, term $(priv_{it} - priv_{it-1})$ becomes more correlated with new error term $(\varepsilon_{it} - \varepsilon_{it-1})$ because they include terms $priv_{it}$ and ε_{it-1}. Given that a better performance in the previous year may raise people's expectation for privatization in the next period, this bias will also generate upwardly biased coefficients. Lastly, poorly reported value for asset and output may introduce measurement error into our regression. Measurement error tends to bias the values of estimated coefficients toward zero.

To control for the endogeneity problems caused by selection bias, first-differencing, and measurement error, this paper adopts an instrumental variable estimation. Equation (2) is thus considered as the main model specification in this study and privatization dummy will be treated as an endogenous variable.

5.2 The choice of instrumental variables

How to choose instrumental variables is a daunting task for researchers because a qualified instrumental variable has to meet two requirements. First, it must be relevant to the included endogenous variable. If the instrumental variables are not or only weakly correlated with the endogenous variable, Equation (2) may become unidentified. Second, the instrumental variable must be distributed independently of the error term in Equation (2). If it fails to be orthogonal to the error term, the endogeneity issue will reemerge in Equation (2). Therefore, we need to carefully weigh our choices of instrumental variables based on these two criteria: relevance and orthogonality.

To find instruments relevant to the privatization dummy, one needs to examine the privatization process in China closely. Privatization in China is mainly driven by the central government policies. After several failed attempts to revive the performance of ill-managed SOEs without giving up state controls, the central government began to advocate a "grasping the large and letting go of the small" policy since 1996. The adoption of this policy is grounded on a realization that with the ever-increasing market competition it becomes very costly for the government to continue to subsidize smaller SOEs operating in some less important, but very competitive markets.

Although the implementation of this policy has been mostly ambiguous, Mattlin (2007) and Yao (2005) examine several hypotheses on causes of privatization. They find that the causes leading to a firm's privatization in China can be summarized as the followings. First, a SOE's current performance is an important factor for the state to decide whether to privatize it or not. Local governments have incentives to privatize better-performing SOE first because doing so may help them to ease their budgetary restraints and maintain the momentum for future reforms. Second, workforce redundancy at a firm may hinder its privatization process. One of the most prominent concerns for the Chinese government in prompting SOE restructuring is the potential massive layoffs and its resulting social unrest. Therefore, firms with more redundant workers may have a lower probability of propensity to be privatized. Third, market competition is found to have significant influence on a firm's privatization tendency. Firms operating in a more

competitive market are more likely to be privatized first because they are more likely to become financial burdens to the local governments due to their slim profit margins. Although a higher degree of market liberalization may cause SOEs' performance to deteriorate, it may also promote more private interests and capabilities to privatize local SOEs. Hence, a SOE may be more likely to be privatized if it operates in a more competitive market environment.

To quantify the causes of privatization in China, net asset per worker, ratio of number of *xiagang* workers to that of total employees, and percentage of workers employed by private enterprises in each province are constructed to measure a firm's performance, worker redundancy and market competition, respectively. Net asset per employee is calculated as net asset of a firm divided by its total number of employees. When a Chinese SOE undertook restructuring reforms, current employees of that SOE were either retained or let go and became redundant workers. The retained workers would continue to work with full compensation. They are thus named "working employees" or "on-duty workers" in this study. The workers who are let go normally become "*xiagang*" or layoff. Different from being laid off, in which case a worker's ties to the firm may be entirely severed, a "*xiagang*" worker refers to one who is no longer actively working but still receiving minimum benefits from firms. To account for degrees of market liberalization in each province, the total number of employees working at private sectors in each province covered in the survey is collected from the *National Bureau of Statistics of China* database. A higher ratio of private employees to the total working employees in a province indicates a higher degree of market liberalization.

To meet the orthogonality condition, the instrumental variables are constructed with one period lag of the aforementioned performance, redundancy and competition variables. The rationale of using lagged values as instrumental variables is threefold. First, a firm's performance, worker redundancy and competition that it faced from the previous period is more likely to help determine its privatization in the current period, but less likely to affect its current productivity. That is, $corr(IV_{it-1}, \varepsilon_{it}) = 0$. Second, the endogeneity in Equation (2) caused by the first-differencing can be addressed. Recall if

$corr(priv_{it}, \varepsilon_{it-1})$ is significantly positive, then a better-performing firm is more likely to be chosen for future privatization. Thus, the first-differenced terms $(priv_{it} - priv_{it-1})$ and $(\varepsilon_{it} - \varepsilon_{it-1})$ are also correlated. When the lagged values of performance, redundancy and competition are used to instrument the first-differenced privatization term, our endogeneity concern is then on the possible correlation between IV_{it-1} and $(\varepsilon_{it} - \varepsilon_{it-1})$, which should be close to zero. This assertion is substantiated by an over-identification test in the next section. Third, by including the lagged instrument variables, the omitted variable bias can also be addressed.

Moreover, instead of taking first-difference of instrumental variables, Wooldridge (2001) suggests that instrumental variables used in a first-differenced panel estimation do not have to be first-differenced themselves. Since there are only seven years in our panel, using lagged first-differenced instrumental variables will cost us two years of data and subsequently decreases the degree of freedom of our estimation significantly. Therefore, only the level values of performance, redundancy and competition are used as instruments in this study. For the same reason, only one lag of instruments is considered.

Based on Equation (2) the final specification of the estimation equation can be shown as follows:

$$(3)\quad y_{it} - y_{it-1} = \beta_1(l_{it} - l_{it-1}) + \beta_2(k_{it} - k_{it-1}) + \beta_3(priv_{it} - priv_{it-1}) + \beta_w'(w_{it} - w_{it-1}) + \beta_{yr}'(year_{it} - year_{it-1}) + (\varepsilon_{it} - \varepsilon_{it-1})$$

Where, the included endogenous variable is $(priv_{it} - priv_{it-1})$; the included instrumental variables are $(l_{it} - l_{it-1})$, $(k_{it} - k_{it-1})$, $(w_{it} - w_{it-1})$, and $(year_{it} - year_{it-1})$; the excluded instrumental variables are $performance_{it-1}$, $redundancy_{it-1}$, and $competition_{it-1}$. $(\varepsilon_{it} - \varepsilon_{it-1})$ follows a normal distribution with mean zero and variance δ_ε^2, but is not assumed to be distributed independently. The model allows arbitrary heteroskedasticity and intra-cluster correlations. An instrumental variable general method of moment (IV-GMM) suggested by *Baum, Schaffer and Stillman (2002)* is adopted to estimate Equation (3).

6. Empirical Tests and Findings

By estimating Equation (3) with IV-GMM, we can study the impacts of privatization on Chinese firms' productivity not only on the year of conversion but also on multiple post-privatization periods. In addition, the effects of partial privatization and a variety of different private ownerships on firm's productivity are also examined with fixed-effects estimations. As alternatives to privatization, the effectiveness of some non-ownership-change reforms on productivity changes among the remaining SOEs is further evaluated. Lastly, to conclude this section, some policy implications on Chinese SOEs restructuring based on our findings are discussed.

6.1 Tests for Endogeneity and Heteroskedesticity

To justify the adoption of IV approach in this study, a Hausman endogeneity test is carried out to compare a consistent estimator (IV estimator) with an efficient estimator (OLS estimator). The test statistic is reported in *Table 6*. The OLS estimators are obtained with a pooled OLS estimation with Equation (2). The IV estimators are retained after a two stage least square (2SLS) estimation based on Equation (3). The null hypothesis is that the IV estimators are not systematically different from the OLS estimators. As *Table 6* shows, the Hausman test rejects the null hypothesis at 10 percent significance level. Thus, there are variables correlated with Equation (2)'s disturbance terms and treatments for endogeneity are necessary and desired.

Table 6 Hausman Specification Test for Endogeneity

$$(\hat{\beta}_{IV} - \hat{\beta}_{OLS})'(\hat{\Omega}_{\beta IV} - \hat{\Omega}_{\beta OLS})^{-1}(\hat{\beta}_{IV} - \hat{\beta}_{OLS}) \sim \chi^2(9)$$

Null hypothesis:

consistent estimator ($\hat{\beta}_{IV}$) is not systematically different from inconsistent estimator ($\hat{\beta}_{OLS}$)

Chi-square statistic: 15.090 P-value 0.084

Note: $\hat{\beta}_{IV}$ is the instrumental variable estimator and estimated by two stage least squares. $\hat{\beta}_{OLS}$ is the ordinary least square estimator. $\hat{\Omega}_{\beta IV}$ and $\hat{\Omega}_{\beta OLS}$ are the estimated covariance matrix of IV and OLS estimators. The degree of freedom of chi-square is 9.

To address potential endogeneity problems, instrumental variable approach poses as a natural choice. By carefully choosing exogenous instruments, this approach can ideally produce efficient and consistent estimators. Among all IV estimation strategies, the 2SLS approach has been popular because, unlike GMM, 2SLS is exactly identified. *Baum, Schaffer and Stillman (2002)* suggest that with absence of heteroskedasticity, a 2SLS IV estimator tends to be more efficient than a GMM IV estimator. However, they also suggest that if the homoskedasticity assumption is violated, a GMM IV approach would be more preferable. Hence, to decide which IV strategy is more appropriate for the model here, a Pagan-Hall heteroskedesticity test is implemented. The test statistic is reported in Table 7. The test is based on the estimated residuals of Equation (3) after a 2SLS estimation. The null hypothesis is that the IV estimation's disturbances are homoskedastic. A chi-square statistic of 25.501 rejects the null hypothesis at 5 percent significance level. Therefore, an IV-GMM approach is favored and used to estimate the effects of privatization on firms' productivity growth. Nevertheless, the adoption of the IV-GMM approach inevitably raises questions of identification. To address these, tests for identification is discussed in the next section.

Table 7 Pagan-Hall Test for Heteroskedesticity in the IV estimation

Null hypothesis: IV estimation's disturbances are homoskedastic
Pagan-Hall test statistic: 25.501 P-value 0.030

Note: This is a test for heterksedesticity for instrumental variable estimations. The test statistic has a chi-square distribution with 14 degree of freedom.

6.2 The impacts of privatization on firms' productivity (IV-GMM results)

The validity of instruments is vital for the success of IV estimations. As discussed earlier, a qualified instrument must meet two requirements: relevance and orthogonality. On the relevance aspect of instruments, we consider a group of variables representing the firms' performance, market competition, and worker redundancy. These variables have been widely regarded as causes of privatization in China. After numerous regressions of possible instruments on the dummy variable of privatization, three variables emerge as our choice of instruments: net asset per worker, the ratio of the total number of employees in private sectors to the total number of working population in each province,

and the ratio of *xiagang* workers to the total number of employees at each firm. A pooled OLS is estimated and the estimation specification is shown as follows.

$$
\begin{aligned}
(4)\; d(priv_{it}) = {} & \alpha_0 + \alpha_1 g(employee)_{it} + \alpha_2 g(asset)_{it} + \sum_{j=1996}^{2000} w_j dyr_{itj} + \beta_1 d(manageshar\ e_{it}) \\
& + \beta_2 d(burdens)_{it} + \beta_3 d(debt)_{it} + \beta_4 d(softbudget)_{it} \\
& + \gamma_1 performance_{it-1} + \gamma_2 redundancy_{it-1} + \gamma_3 competition_{it-1} + \upsilon_{it}
\end{aligned}
$$

The dependent variable in Equation (4) is the first-difference privatization dummy. The independent variables include all explanatory variables from the structural model (Equation (2)) as included instruments and the lagged performance, redundancy and competition variables as excluded instruments. Table 8 reports the estimation results. All excluded instruments are significant at 10 percent significance level and consistent with findings from previous literature. Firms with higher net asset per employee or facing increased market competition are more likely to be privatized whereas higher worker redundancy hinders privatization decision. As Wooldridge (2002) points out, level variables may tend to be weakly correlated with first-differenced variables. Such weak correlations between instruments and endogenous variables may cause the IV estimation to produce biased estimators. Therefore, a F-test and Kleibergen-Paap Lagrangian multiplier tests (K-P LM) are implemented to examine the relevance of the excluded instruments. These tests have been recommended by *Baum, Schaffer and Stillman (2002)*. The null hypothesis of the F-test is that the estimated coefficients of the excluded instruments are not jointly different from zero. The test statistic is shown in the upper rows of Table 9 and the null hypothesis is rejected at 10 percent significance level. The null hypothesis of the K-P LM test is that the coefficient matrix of Equation (4) does not have full rank, an indication of weak correlation between the excluded instruments and the endogenous variable. Thus, failing to reject the null hypothesis would suggest that the model is underidentified. Similar to the F-test results, The K-P LM test results reinforce our choice of instruments by rejecting the null hypothesis at 10 percent significance level.

Table 8 Causes of Privatization
(Pooled OLS of Equation (4))

Pooled OLS	
Dependent variable: D(private)	
constant	0.004
	(0.008)
g(on-duty workers)	0.003
	(0.004)
g(asset)	-0.048*
	(0.027)
D(year 1996)	-0.002
	(0.004)
D(year 1997)	-0.005
	(0.008)
D(year 1998)	0.011
	(0.013)
D(year 1999)	0.008
	(0.013)
D(year 2000)	0.002
	(0.009)
D(manager share)	0.013***
	(0.001)
D(social burdens)	-0.01
	(0.012)
D(excessive debt)	0.004
	(0.005)
D(soft budget)	0.000
	(0.000)
lag (competition)	0.439*
	(0.213)
lag (redundancy)	-0.018*
	(0.008)
lag (performance)	0.001*
	(0.000)
Number of obs: 1184	
R-square: 0.507	

Note: This table presents the pooled estimation of Equation (4). g, D and lag refer to growth, first difference and lag term, respectively. It is used as specification for F and K-P LM underidentification tests. Competition is the ratio of private sector employees to total employees in each province. Redundancy is the ratio of *xiagang* workers over total employees of a firm. Performance is the net asset per employee. Robust standard errors are in parenthesis and *, **, *** indicate the 10%, 5%, and 1% significance levels respectively.

Table 9 Underidentification Test for IV-GMM Estimation

F-test of excluded instruments

H_0: the estimated coefficients of instruments are jointly equal to zero

F test statistic: 2.38 Prob > F: 0.069

Kleibergen-Paap LM test for underidentification

H_0: Matrix of reduced form coefficients does not have full rank (underidentified)

Chi-square statistic: 7.16 P-value: 0.067

Note: This table reports two underidentification tests for the excluded instruments based on Equation (4). The F-test is a joint test and the K-P test is a Lagrangian multiplier test. Reduced form refers to Equation (4). The F-test and K-P LM test both have 3 degrees of freedom.

Table 10 reports results from estimating Equation (3) with IV-GMM, the preferred model specification, and illustrates the impacts of privatization on firms' productivity in China, the central focus of our interest. First, to one's surprise, it is found that productivity growth rate at privatized firms is not significantly higher than that at SOEs in the year of conversion. This finding may be largely attributed to transitory costs. *Jefferson and Su (2006)* argue that the impacts of privatization may not be immediately observable since the initial gains may be offset by the costs of transition. If ownership transformation does matter to firms' efficiency improvement, its effects would more likely emerge later in the post-privatization periods.

Second, all reform measures but management incentive are shown to improve firms' productivity significantly. Easing workforce redundancy and excessive debts may contribute to productivity growth by 37.3 percent and 5.3 percent, respectively. In addition, the effect of hardening soft-budget constraint on productivity growth is found to be significant although the magnitude is small. Third, regarding the impacts of production factor growths on firms' productivity growth, labor input has on average boosted output growth by 20.8 percent from 1995 to 2001 and the comparable contribution of capital input on productivity growth is higher, with the average of 43.5 percent impact during the same period.

Third, coefficients from time dummies indicate a "V" shape change in firms' productivity growth in China from 1996 to 2001. The growth rates of productivity have continuously decreased by 8, 10.8 and 21.8 percents in China from 1996 to 1998, respectively. The decreasing trend of productivity growth continued in 1999, but it

slowed to 11.1 percent. Such persistent falls of productivity growth rates may be attributed to the tightened monetary policies in China from 1995 to 1998. With erratic economic growths from 1980s to 1995, China experienced serious inflation in 1993-1995. Inflation rate in China had increased to 14.7 percent from 6.4 percent a year before and peaked at 24.1[7] percent in 1994. To tame the inflation, Chinese government dramatically restricted state-owned banks lending practice. As a result, inflation dropped sharply after 1995 and so did the GDP growth rate. Chinese GDP growth rates declined steadily from 10.9 percent in 1995 to 7.6 percent in 1999 and subsequently slowly recovered to 8.4 percent in 2000.[8] Taking these policy changes into account, our estimation results on time dummies have well captured the impacts of these overall economic slowdowns.

[7] The data are from 2009 World Economic Outlook by International Monetary Fund.
[8] The data are from World Development Indicators by World Bank.

Table 10 Impacts of Privatization on Firm's Productivity

Dependent variable g(output)	OLS	2SLS	IV-GMM
constant	-0.031*	-0.064*	-0.068**
	(0.018)	(0.038)	(0.034)
d(private)	0.038	3.699	3.648
	(0.159)	(3.251)	(2.902)
g(on-duty workers)	0.245***	0.234***	0.208**
	(0.056)	(0.069)	(0.085)
g(asset)	0.272***	0.442***	0.435***
	(0.074)	(0.176)	(0.166)
d(year 1996)	-0.106***	-0.091*	-0.088**
	(0.040)	(0.052)	(0.038)
d(year 1997)	-0.137***	-0.105	-0.108*
	(0.050)	(0.068)	(0.058)
d(year 1998)	-0.191***	-0.215***	-0.218***
	(0.051)	(0.063)	(0.068)
d(year 1999)	-0.099**	-0.109*	-0.111*
	(0.047)	(0.057)	(0.065)
d(year 2000)	-0.043	-0.040	-0.043
	(0.037)	(0.045)	(0.052)
d(manager shares)	-0.002	-0.051	-0.050
	(0.003)	(0.044)	(0.039)
d(social burdens)	-0.424***	-0.380**	-0.373*
	(0.131)	(0.158)	(0.207)
d(excessive debts)	-0.037**	-0.054**	-0.053**
	(0.017)	(0.025)	(0.024)
d(soft budget)	0.000	0.000	0.000**
	(0.000)	(0.000)	(0.000)
Obs.	1194	1184	1184
R-square	0.069		
Root MSE		0.698	0.692

Note: OLS reports the pooled OLS first-differenced estimation results. 2SLS reports a standard 2 stage least square estimation results without adjusting for heteroskedesticity and intra-cluster. IV-GMM reports the baseline instrumental variable general method of moment results based on Equation (3). Standard deviations are in parenthesis. *, **, *** indicate the 10%, 5%, and 1% significance levels respectively.

Lastly, a Hansen J test is used to examine if the excluded instruments are correlated with the structural model's disturbance term. The null hypothesis of the test is that the excluded instruments are not orthogonal to the model disturbance. Table 11 shows the test statistic. The chi-square statistic is 0.568, which fails to reject the null hypothesis. We also conduct a C-test to see if any other variables in the structural model (Equation (2)) should be considered as endogenous in addition to the privatization

dummy. The test results indicate that only the privatization dummy should be considered as endogenous and receives IV treatment.

Table 11 Overidentification and Endogeneity Tests

Overidentification Test
H_0: Instruments are *not* orthogonal to the model disturbance
Hansen J statistic: Chi-square 0.568 P-value 0.753
Endogeneity Test
H_0: the endogenous variable d(private) can be treated as an exogenous variable
C-test statistic: Chi-square 3.064 P-value 0.080

Note: The overidentification jointly tests if all instruments (included and excluded) are correlated with the error term. The endogeneity test examines if the chosen endogenous variable df(private) can be appropriately considered as an endogenous variable. These two tests are documented by Baum, Schaffer, and Stillman (2002).

6.3 The dynamics of privatization

Besides the contemporaneous effects of privatization on firms' productivity, the dynamics of privatization, post-privatization in particular, are also worth exploring. Although privatization may fail to exhibit any significant impacts in the year of conversion due to various causes, its effects may begin to appear after the early transitory periods. To estimate the effects of privatization in the post-transition periods, we construct two time dummies, 1st year and 2nd year after privatization, to replace the privatization dummy in Equation (3) and estimate the equation with IV-GMM. The estimated coefficients are reported in Table 12 and the results from a pooled first-difference OLS model are also presented in Table 12 for comparison. Being limited by the short time series of the data, only two years post-privatization effects are studied. The IV GMM estimation finds that firms' productivity has, on average, increased by 214 percent after the first year of conversion. However, the effects faded out and became negative and insignificant in the second year after privatization.

Moreover, we analyze whether or not and to what degree the endogeneity problems have been controlled by the preferred IV-GMM estimation approach. The test strategy is adopted from Brown et al. (2006). Brown et al. (2006) illustrate that without properly addressing selection bias, firms tend to exhibit significant improvements on their performance in the immediate years prior to privatization because managers have incentives to make their firms look better to attract future private buyers or owners. On

the other hand, such anticipatory effects should disappear if selection bias is sufficiently controlled. Following this strategy, we replace the privatization dummy in Equation (3) with two time dummies: one year and two years prior to privatization. The estimation results are presented in Table 13. All pre-privatization dummies are significantly positive in the years prior to privatization in the first-difference OLS specification whereas no anticipatory effect is found in the IV-GMM specification. This result further indicates that OLS estimation may pose serious selection bias problems and that the endogeneity problems have disappeared after the model is estimated with the IV GMM approach.

Table 12 Effects of Post-Privatization on Firms' Productivity

	Pooled first-differenced OLS Dependent: g(output)	IV-GMM Dependent: g(output)
Constant	-0.137	-0.048**
	(0.274)	(0.020)
d(1st year after private)	0.117	2.140*
	(0.093)	(1.006)
d(2nd year after private)	0.145	-1.191
	(0.118)	(4.610)
g(On-duty workers)	0.245***	0.249***
	(0.056)	(0.090)
g(Asset)	0.266***	0.150
	(0.073)	(0.144)
d(Year dummies)	yes	yes
d(Manager shares)	-0.001	0.000
	(0.002)	(0.002)
d(Social burdens)	-0.420***	-0.347*
	(0.131)	(0.184)
d(Excessive debts)	-0.038**	-0.050**
	(0.017)	(0.021)
d(Soft budget)	0.000	0.000**
	(0.000)	(0.000)
N	1194	1184
adj. R^2	0.070	
Root MSE		0.696

Note: This table shows the post-privatization effects on firms' productivity and its growth. All variables in the OLS specification are in levels. All variables in the IV-GMM specification are in first-differences. Standard deviations are in parenthesis. *, **, *** indicate the 10%, 5%, and 1% significance levels respectively.

Table 13 Effects of Pre-Privatization on Firms' Productivity

	Pooled OLS Dependent: output Independents in levels	IV-GMM Dependent: g(output) Independents in first differences
Constant	-0.122	-0.066*
	(0.275)	(0.040)
1st year before private	0.219*	3.046
	(0.120)	(4.386)
2nd year before private	0.206*	1.385
	(0.123)	(13.251)
On-duty workers	0.345***	0.203
	(0.041)	(0.138)
Asset	0.677***	0.103
	(0.040)	(0.221)
Year dummies	yes	yes
Manager shares	0.002	0.040
	(0.002)	(0.058)
Social burdens	-0.782***	-0.414
	(0.108)	(0.289)
Excessive debts	-0.068***	-0.015
	(0.010)	(0.028)
Soft budget	0.000	0.000
	(0.000)	(0.001)
Obs.	1562	1184
adj. R^2	0.706	
Root MSE		0.709

Note: This table shows the anticipation effects of privatization. All variables in the OLS specification are in levels. All variables in the IV-GMM specification are in first-differences. Standard deviations are in parenthesis. *, **, *** indicate the 10%, 5%, and 1% significance levels respectively.

6.4 Partial privatization and different types of private ownership

Among different ways of reforming SOEs, partial privatization has been highlighted as a favored model for SOE restructuring by Chinese policymakers. Chinese government believes that partial privatization can introduce new private capital and technology to ailing SOEs, but at the same time help to preserve the state control. Without much radical reform, social stability can also be maintained at a partially privatized SOE. In line of this belief, Amess, Du and Girma (2009) find that unlike full privatization, partial privatization tends to cause job creation and that partial privatization also results in wage increase for employees. However, the effectiveness of partial privatization on productivity is still uncertain. Indeed, a partial privatization may

stimulate a firm's performance in many ways, such as technological change, profitability, and corporate governance, etc. On the other hand, with only minor shares sold to private investors, the state may continue to exercise substantial influence over firms' operation and thus fail to boost reformed SOEs' efficiency.

To provide further insights on this issue, the effects of partial privatization are estimated. A firm is considered being partially privatized if the total private shares in a firm exceeds 0 percent but are equal to or fewer than 50 percent. An IV-GMM approach based on Equation (3) with the remaining SOEs is first considered to address the possible endogeneity problem. The endogeneity test results (C-test) show that the partial privatization dummy is not endogenous. As a result, the IV approach is probably not necessary. Nonetheless, a Hausman test still warns the possible presence of endogeneity and favors fixed-effects approach. The fixed-effects results for partial privatization are presented in Table 14 along with results from OLS. Without controlling for endogeneity, the OLS results indicate a significant and positive effect of partial privatization whereas partial privatization becomes insignificant after individual effects are controlled for in the fixed-effects estimation. To examine the dynamics of partial privatization, two post-partial privatization binary indicators are also included in the fixed-effects estimation and none of them appears significant. In sum, partial privatization probably should not be regarded as an equal alternative to full privatization because it fails to exhibit any significant impacts on SOEs' productivity improvements.

In addition to partial privatization, the effects of four different types of private ownerships are shown in the lower portion of Table 14. These four categories of private ownership are insider, outsider, domestic and foreign privatizations, respectively. Insider, outsider and domestic, foreign are estimated separately in two estimations with the same set of explainable variables as in Equation (3). Table 14 shows that there is no contemporaneous effect from any type of private ownership. However, when post-privatization dummies (two years after privatization) are included (not shown here), productivity at SOEs privatized by insiders has increased by 27 percent with 10 percent significance level after the first year of conversion. Nonetheless, this effect quickly fades

in the second year after conversion. Previous literature has found that the effects of insider privatization are mixed at most. Li and Rozelle (2003) argue that performances of insider privatized firms are dependent on the sale price paid by the insiders in China. Firms owned by insiders who paid price exceeding the book value more likely will perform better. Blanchard and Aghion (1996) study privatization in Eastern European countries and find that insider ownership actually impedes further desirable restructurings.

The significant effects of insider privatization in our study may suggest several explanations. First, after aligning property rights with corporate governance, firms' efficiencies are improved dramatically because managers and workers become better motivated. The positive effects quickly fading out in the following periods reflects some inherent flaws of insider privatization, such as lack of new funding, higher wages and more importantly diffused ownerships (Estrin and Rosevear (2003) pp.462-465).

Table 14 Effects of Partial Privatization and Different Private Ownerships on Firms' Productivity

	OLS	FE
Dependent variable: output		
Partial privatization	0.006*	0.007
	(0.003)	(0.007)
Insider privatized	-0.293	0.121
	(0.173)	(0.212)
Outsider privatized	0.103	0.012
	(0.108)	(0.168)
Domestic privatized	-0.050	0.022
	(0.099)	(0.148)
Foreign privatized	0.485	0.237
	(0.297)	(0.365)

Note: This table shows the effects of partial privatization and insider, outsider, domestic and foreign privatization. Partial privatization refers to that the total private shares in a firm ≤50%, but ≥0%. So, a partially privatized firm is still considered as a SOE. Insider, outsider and domestic and foreign privatized are firms in which insider, outsider, domestic and foreign shares exceed 50 percent, respectively. So, these firms are considered as privatized. All estimations in this table are done based on Equation (2)'s specification with the privatization binary indicator replaced by private shares or insider and outsider privatization dummies or domestic and foreign privatization dummies. Standard deviations are in parenthesis. *, **, *** indicate the 10%, 5%, and 1% significance levels respectively.

6.5 Non-ownership-change restructurings

The retreat of state control on SOEs has been slowed down dramatically in the past decade. Imai (2006) quotes the cost of financing restructuring, the role of the State as the dominant shareholder, and the balance between the state's and managers' interests as major constraints of motivating deeper reforms. Thus, keeping and managing some SOEs have become increasingly attractive to Chinese government. Mattlin (2007) also closely examines the latest attempts by the state to retain and manage large SOEs. By adopting some efficiency-oriented non-ownership-change restructurings, the state hopes that the remaining SOEs can not only survive but thrive in this new economy. As such, most of SOEs have been forced to go through at least one form of non-ownership-change restructuring during the survey period. However, the impacts of restructurings without relinquishing state ownership on SOEs' productivity are still largely unknown.

To shed lights on the productivity effects of non-ownership-change restructuring, we use a fixed-effects model with data excluding privatized firms. The model specification can be written as

$$(5)\ output = \alpha_0 + \alpha_1 employee_{it} + \alpha_2 asset_{it} + \sum_{j=1996}^{2000} w_j dyr_{itj} + \sum_{j=1}^{7} \rho_j (restructurings)_{itj} + v_{it}$$

where restructurings include internal restructuring, bankruptcy, IPO, employee shareholding, open sales, leasing and joint venture. The results are reported in the first two columns in Table 15. The OLS results are presented for comparison purpose. In the fixed effects model, none of the non-ownership-change restructuring policies is significant. However, all production factors and time dummies exhibit predicted signs and are also significant. One possible explanation to the insignificance of the restructuring variables is that these restructuring efforts are primarily targeting at the reallocation of property rights and thus they do not directly affect firms' efficiency if no further steps are taken to address issues like managerial incentives, social burdens, excessive debts or soft-budget constraints. Thus, without controlling these reform

measures, non-ownership-change restructuring by itself may not be as effective as the policy makers think.

To test the validity of this argument, we revise Equation (5) by taking into account of the aforementioned reform measures. The results are shown in the last two columns of Table 15. Among all reform measures, the coefficients of social burdens and excessive debts appear to have negative effects on productivity improvement at 1 percent significance level. More importantly, leasing, as a non-ownership restructuring, increases SOEs productivity by 55 percent and this result is significant at 10 percent significance level. Nonetheless, all other non-ownership-change restructurings continue to show insignificant effects on productivity. It seems that the effectiveness of various non-ownership-change restructurings is different and that there is an optimal sequence for non-ownership reforms to be truly effective. Without reducing a SOE's social obligations and easing its excessive debts first, any non-ownership-change restructuring efforts may end up in vain. If these two problems are appropriately addressed before any reforms to take place, leasing SOEs to investors may be a more rewarding strategy if the priority of policymakers is to revitalize firms' productivity.

Table 15 Effects of Non-Ownership Restructuring on Firms' Productivity

Dependent output	OLS without other reforms	FE without other reforms	OLS with other reforms	FE with other reforms
On-duty worker	0.609***	0.503***	0.319***	0.362***
	(0.026)	(0.033)	(0.035)	(0.056)
Asset	0.454***	0.484***	0.757***	0.518***
	(0.023)	(0.056)	(0.032)	(0.080)
1996	-0.179**	-0.161***	-0.183**	-0.159***
	(0.080)	(0.044)	(0.092)	(0.059)
1997	-0.255***	-0.260***	-0.219**	-0.196***
	(0.081)	(0.045)	(0.090)	(0.060)
1998	-0.244***	-0.317***	-0.201**	-0.243***
	(0.082)	(0.047)	(0.091)	(0.064)
1999	-0.202**	-0.285***	-0.160*	-0.189***
	(0.083)	(0.049)	(0.092)	(0.068)
2000	-0.106	-0.252***	-0.068	-0.148**
	(0.084)	(0.051)	(0.094)	(0.071)
2001	-0.036	-0.201***	-0.038	-0.164**

		Non-Ownership Restructurings		
	(0.086)	(0.054)	(0.097)	(0.076)
Internal Res	0.113	0.096	-0.049	0.123
	(0.101)	(0.097)	(0.122)	(0.136)
Bankruptcy	-0.199	-0.072	-0.342*	-0.022
	(0.154)	(0.177)	(0.206)	(0.299)
IPO	0.533***		0.380	
	(0.178)		(0.512)	
Shareholding	0.588***	0.087	0.260	0.111
	(0.116)	(0.130)	(0.158)	(0.203)
Open sales	0.481**	0.208	-0.531	0.111
	(0.222)	(0.242)	(0.397)	(0.506)
Lease	0.304**	0.143	0.185	0.549*
	(0.139)	(0.154)	(0.201)	(0.297)
Joint venture	1.151***		0.744**	
	(0.279)		(0.300)	
		Other Reform Measures		
Manager shares			0.043	0.010
			(0.028)	(0.030)
Social burdens			-0.986***	-0.499***
			(0.088)	(0.153)
Excessive debts			-0.100***	-0.040***
			(0.008)	(0.015)
Soft budget			-0.000	0.000
			(0.000)	(0.000)
Constant	-0.524***	-0.035	-0.284	0.793
	(0.132)	(0.410)	(0.177)	(0.645)
Obs.	2285	2285	1407	1407
adj. R^2	0.617		0.708	
Within R^2		0.225		0.209

Note: This table shows the effects of non-ownership restructuring and other reform measures on remaining SOEs' productivity. The estimations are based on Equation (2) and only remaining SOEs are considered. Standard deviations are in parenthesis. *, **, *** indicate the 10%, 5%, and 1% significance levels respectively.

7. Conclusion

Privatization has gained momentum in China as a major alternative reform strategy to revitalize ailing SOEs after it received endorsement from Chinese government in 1995 with the policy of "retain the large and let go of the small". After more than a decade of reform, findings on the effects of privatization on firms' efficiency, however, are still mixed. To contribute to this ongoing inquiry, this paper chooses to focus on the impacts of privatization on Chinese SOEs' total productivity with a panel data of 863 Chinese firms in 11 cities from 1995 to 2001.

Previous studies on Chinese privatization have been mostly haunted by endogeneity problems. The sources of the endogeneity may come from selection bias, omitted variables or even first-difference treatment in a panel context. To address these concerns, privatization dummy at the year of conversion is treated as an endogenous variable in this paper and instrumented with three chosen exogenous variables. These three instrumental variables measure a firm's performance, worker redundancy and provincial market liberalization. These factors have been widely documented in previous studies as causes of privatization in China. After a series of tests, these instruments are proved to be relevant to the endogenous variable and orthogonal to the disturbance term in the structural model. Due to the presence of heteroskedesticity and intra-clustering, the model is estimated with a first-difference IV-GMM approach. Further tests confirm that our results are free from endogeneity bias.

Our results indicate that privatization fails to boost firms' productivity in the year of conversion, but it does yield significant and positive impacts until one year after privatization takes place. The insignificance can probably be explained by transition costs that occur in the first year of privatization. Moreover, some reform measures are also controlled in the privatization effect estimation because Chinese SOE reform policies and our survey data both suggest that Chinese firms, regardless of ownership, may all face some challenges and hindrances that impede efficiency improvement. These hindrances may range from social burdens resulting from benefit payments to retired employees,

excessive debts, and soft-budget constraint to management incentives. Without controlling these variables, the coefficient of privatization is likely biased upward.

In addition, we find that partial privatization leads to insignificant improvement in efficiency at SOEs. To investigate how various private ownerships affect firms' productivity all privatized firms are disaggregated into insider and outsider or domestic and foreign privatized firms. Except insider privatization being found to lead to higher productivity, none of other private ownerships shows impacts on productivity.

Lastly, the effects of several non-ownership-changes restructuring on productivity are also examined among those firms that remain as SOEs. The motivation of this exercise is largely due to the fact that Chinese government has become more interested in preserving state control in some strategic SOEs in recent years of reform. Mattlin (2007) and Imai (2006) analyze this new phenomenon and contend that some non-ownership-change restructuring attempts have been made at remaining SOEs to improve their viability without losing state control. In our evaluation of the effectiveness of this strategy, we find that non-ownership-change restructurings may become wasteful if soft-budget constraint and excessive debts problems are not fully addressed first. Further, even if a non-ownership-change reform is properly executed, its effect on productivity is still much lower than that from privatization.

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